

DTIC FILE COPY

12

TG-141

AD-A180 370



**UNITED STATES ARMY
ENVIRONMENTAL HYGIENE
AGENCY**

ABERDEEN PROVING GROUND, MD 21010-5422

INDUSTRIAL HYGIENE SAMPLING INSTRUCTIONS

DTIC
ELECTE
MAY 20 1987
S D

A
E
H
A

20030/27042

Approved for public release; distribution is unlimited.

87 5 14 013

Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, U.S. Army Environmental Hygiene Agency, ATTN: HSHB-ML-0, Aberdeen Proving Ground, MD 21010-5422.

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

ADA180370

REPORT DOCUMENTATION PAGE				Form Approved OMB No 0704-0188 Exp Date Jun 30, 1986	
1a REPORT SECURITY CLASSIFICATION UNCLASSIFIED			1b RESTRICTIVE MARKINGS		
2a SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.		
2b DECLASSIFICATION/DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Guide (TG) 141			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a NAME OF PERFORMING ORGANIZATION US Army Environmental Hygiene Agency		6b OFFICE SYMBOL (if applicable)	7a NAME OF MONITORING ORGANIZATION		
6c ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, MD 21010-5422			7b ADDRESS (City, State, and ZIP Code)		
8a NAME OF FUNDING/SPONSORING ORGANIZATION		8b OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
			WORK UNIT	ACCESSION NO.	
11. TITLE (Include Security Classification) Industrial Hygiene Sampling Instructions (Unclassified)					
12. PERSONAL AUTHOR(S) FREDERIC BELKIN and RICHARD W. BISHOP					
13a TYPE OF REPORT Technical Guide		13b TIME COVERED FROM TO	14 DATE OF REPORT (Year, Month, Day) March 1997		15 PAGE COUNT 58
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP			
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This technical guide describes air and bulk industrial hygiene sampling procedures for over 100 potentially hazardous chemical contaminants. The guide contains air volumes, sampling rates and references for IH air sampling. It addresses the types of containers and amount of sample required for bulk samples. Procedures for submitting samples including a listing of Army laboratories that perform industrial hygiene chemistry analysis are provided. The guide lists the expendable monitoring supplies that are compatible with the sampling procedures and includes representative commercial sources.					
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED		
22a NAME OF RESPONSIBLE INDIVIDUAL FREDERIC BELKIN and RICHARD W. BISHOP			22b TELEPHONE (Include Area Code) AUTOVON 584-2208		22c OFFICE SYMBOL HSHB-ML-0

DD FORM 1473, 84 MAR

83 APR edition may be used until exhausted
All other editions are obsolete

SECURITY CLASSIFICATION OF THIS PAGE

UNCLASSIFIED

CONTENTS

	Paragraph	Page
General Sampling Instructions.....	1	1
Asbestos Sampling.....	2	3
Crystalline Silica (Quartz) Sampling.....	3	4
Filter Sampling.....	4	4
Adsorption Tube Sampling.....	5	6
Impinger Sampling.....	6	8
Bulk Sampling.....	7	8
Passive (Diffusion Type) Monitor.....	8	9
Radon Sampling.....	9	10
Field Blanks.....	10	10
Procedures for Submitting Samples.....	11	11

APPENDIXES

A - TABLES.....	A-1
A-1 - Air sampling procedures for chemical contaminants.....	A-2
A-2 - Bulk sampling procedures for chemical contaminants.....	A-13
A-3 - Documentation of IH air sampling procedures.....	A-14
B - IH MONITORING SUPPLIES AND VENDORS.....	B-1
C - SUPPORTING LABORATORIES AND AREAS SERVED.....	C-1
D - INSTRUCTIONS FOR COMPLETING USAEHA FORM 9-R, INDUSTRIAL HYGIENE AIR SAMPLE DATA.....	D-1
E - INSTRUCTIONS FOR COMPLETING USAEHA FORM 8-R, BULK SAMPLE DATA.....	E-1
F - REFERENCES.....	F-1
G - SELECTED BIBLIOGRAPHY.....	G-1
GLOSSARY.....	GLOSSARY 1

QUALITY
INSPECTED
4

Accession For	
NTIS CRA&I	<input checked="" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and for Special
A-1	



DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010-5422

REPLY TO
ATTENTION OF

NSHB-ML-O

March 1987*

USAEHA TECHNICAL GUIDE NO. 141
INDUSTRIAL HYGIENE SAMPLING INSTRUCTIONS

1. GENERAL SAMPLING INSTRUCTIONS

a. Industrial hygiene (IH) sampling procedures are summarized in tables A-1, A-2, and A-3.

(1) Table A-1 lists the chemical contaminant, sampling method, recommended sample volume range in liters, and a procedure number corresponding to those procedures performed at the U.S. Army Environmental Hygiene Agency, Aberdeen Proving Ground (USAEHA APG). The procedure numbers are provided as guidance to the industrial hygienists serving USAEHA APG, and do not apply to those methods used by USAEHA field support activities (FSA). Appearing at the end of table A-1 are alternate sampling methods for several chemical parameters. These methods are to be used when submitting samples to the FSA Fitzsimons Army Medical Center (FAMC) laboratory for analysis of these parameters.

(2) The recommended sampling rates and air volumes listed in table A-1 are consistent with documented procedures published by the National Institute for Occupational Safety and Health (NIOSH), American Society for Testing and Materials (ASTM), manufacturers of sampling media, etc. Sampling done based on these recommendations will reasonably ensure that the accuracy and detection limit requirements of the analytical measurement system are met while also minimizing the potential for exceeding kinetic or saturation capacities of the sampling device(s). It is recognized, however, that situations may arise which necessitate deviation from these guidelines.

Use of trademarked names does not imply endorsement by the U.S. Army, but is intended only to assist in identification of a specific product.

* This technical guide supersedes TG-141, Industrial Hygiene Sampling Instructions, October 1984, and Errata No. 1, 28 June 1985.



For example, a workplace may contain sufficiently high concentrations of a contaminant to require the usage of a "lower-than-recommended" flow rate in order to meet sampling time requirements, or may warrant a lower total sample volume; this is not uncommon with filter sampling in dusty areas. Similarly, pump or time constraints could conceivably lead to the need to sample a "higher-than-recommended" air volume. Since there is a safety factor built into the volume recommendations, there may be no problem with "breakthrough"; but it should be remembered that high humidity or the presence of additional adsorbing compounds could significantly reduce this safety factor. Therefore, while deviations from the recommended volumes may be made, such changes require the exercise of trained judgment and should be made only on an individual case basis.

(3) Table A-2 lists bulk sampling procedures for chemical contaminants. Details are given about container and sample size requirements.

(4) Table A-3 lists the sampling method, analytical method, coefficient of variation (CV), reference, and procedure number for those procedures performed at USAEHA APG. Equivalent documentation for the procedures performed at the FSA should be obtained from their individual laboratories. The CVs included in table A-3 are given for the measurement system which includes the sampling and analytical method. Where sampling errors have not been determined, a 5 percent sampling error has been assumed and included with the analytical measurement error to produce the CV for the procedure. Some procedures listed in table A-3 are not validated (NV). These procedures are assumed to be state-of-the-art and/or the most reliable methods available; however, they have not undergone validation testing such as outlined by NIOSH in the Manual of Analytical Methods, 3rd Edition. The gravimetric procedures employed at USAEHA APG are not considered validated because they deviate significantly from the NIOSH methods. Many chemical substances in the tables have the same USAEHA APG procedure number because they utilize the same analytical procedure for analysis.

(5) Appendix B, section I, tables B-1 through B-4, contain lists of monitoring supplies compatible with the procedures given in the sampling instructions in this guide. The supplies listed in the tables are intended only to assist in identifying a specific product. Other sources may be available for supplying equivalent items. Appendix B, section II, lists

the addresses and telephone numbers of vendors who supply the items listed in tables B-1 through B-4.

b. The supporting laboratory should be contacted prior to sampling for contaminants whenever assistance is needed or for contaminants not listed in table A-1.

(1) Continental United States (CONUS).

(a) USAEHA APG:

For asbestos, quartz, and metals contact the Radiological and Inorganic Chemistry Division (AUTOVON 584-2619)

For organics, solvents, acid mists, and pesticides contact the Organic Environmental Chemistry Division (AUTOVON 584-2208).

(b) Field Support Activities:

For metals, organics, solvents contact either -
FSA Fort McPherson, GA (AUTOVON 572-3234) or
FSA Fitzsimons Army Medical Center, CO (AUTOVON 943-8288)

(2) Outside Continental United States (OCONUS). Consult the appropriate supporting laboratory in appendix C.

c. Swipe, wipe, and swab samples should not generally be submitted except by prior approval from the supporting laboratory. The sample collecting material very often presents interferences in analysis. Contact the appropriate laboratory for guidance on collecting swipe, wipe, or swab samples.

2. ASBESTOS SAMPLING

a. Asbestos samples are collected on 25 mm diameter, 0.8 μ m pore size, cellulose esters (CE) filters in open face cassettes with 50 mm extension cowl. Sample with the open end of the sampler facing downward. Do not use 37 mm filters because sufficiently low detection limits may not be attained.

b. A sample volume of 360 liters will permit detection of fibers at one-tenth the current permissible exposure limit (i.e., 0.02 fibers per cubic centimeter) using phase contrast microscopical counting techniques. A sample volume of 720 liters is desirable to permit reliable quantitation at this level. Sample at a rate between 0.5 and 2.5 liters per minute.

c. When positive asbestos fiber concentrations can be anticipated (e.g., from prior experience), optimal loading of the sample filters for counting purposes can be achieved.

(1) The range of sample volumes to be collected can be estimated by dividing the anticipated fiber concentration into the constants 40 and 500. For example, if the estimated concentration is 1 fiber per cc, then collect between 40 and 500 liters.

(2) For expected low fiber concentrations (less than 0.1 fiber/cc), excessive volumes are required and optimal loading of the sample filter should not be attempted.

d. For asbestos abatement sampling (after asbestos removal) collect 1300 liters (25 mm filters) or 3000 liters (37 mm filters) as noted in table A-1.

e. All asbestos air samples are analyzed by phase contrast microscopy. USAEHA does not perform electron microscopy analyses such as scanning electron microscopy or transmission electron microscopy.

3. CRYSTALLINE SILICA (QUARTZ) SAMPLING

a. Respirable quartz samples are collected on 37 mm diameter, 5 μ m pore size, polyvinyl chloride (PVC) membrane filters for x-ray diffraction analysis for weight of quartz present. Closed-face sample cassettes are mounted in 10 mm nylon cyclones, and a minimum sample volume of 500 liters is collected at a flow rate of 1.7 liters per minute.

b. Crystalline silica samples can be examined qualitatively by x-ray diffraction for the presence of cristobalite and/or tridymite. However, the lack of suitable laboratory standards for these crystalline silica species precludes quantitative analysis.

4. FILTER SAMPLING

a. Types of filters used are:

(1) CE, which is a mixed cellulose ester filter (the same as cellulose nitrate).

(2) Polyvinyl chloride (PVC).

(3) Glass Fiber (GF).

(4) Polymer of tetrafluoroethylene (PTFE).

b. When sampling for metals, dust, and oil mist, use the maximum sampling rate consistent with good pump operation to meet the minimum recommended volume for reliable analysis. However, care should be taken when collecting air samples for metals during sanding and grinding operations to avoid filter over-loading, which may occur due to short-term generation of large volumes of material.

c. At least one field blank filter will be submitted with each set of samples from the same sampling series; if the number of samples in a set exceeds ten, then submit one blank for each ten samples. Asbestos analysis requires a minimum of two blanks, and chromium VI, potassium hydroxide, and sodium hydroxide require at least three blanks. When using preweighed filters, always use corresponding blank filters from the same lot as the samples. The lot can be determined from the code on the top of the USAEHA preweighed filter.

d. After sampling, preweighed filters must be returned to the supporting laboratory that performed the first weighing.

e. Some air contaminants may be collected and analyzed on the same filter. An example is the simultaneous sampling and analysis for lead and total chromium. The following list includes air contaminants which must be collected and analyzed on an individual basis:

- (1) antimony
- (2) molybdenum
- (3) potassium hydroxide
- (4) sodium hydroxide
- (5) chromic acid mist
- (6) chromium VI

f. Some PVC filters, specifically catalog number BSWP from the Millipore Corporation, are not acceptable for sampling chromium VI. This filter has been found to reduce a significant amount of the chromate spike. The NIOSH Sampling Method 7600 suggests use of catalog number FWSB [MSA] or number VM-1 [GELMAN] or equivalent. The storage stability for chromium VI samples has been validated for only a 2-week holding time, therefore, the USAEHA should be notified of analytical requirements prior to the collection of the samples.

5. ADSORPTION TUBE SAMPLING

a. Various types of adsorption tubes are used according to the contaminant being sampled; some of these are charcoal, Tenax®, silica gel, Florisil® and XAD-2®. Table A-1 lists the contaminants and corresponding adsorption tubes. Appendix B lists the sources for consumable supplies (containers, filters, passive monitors, sampler types) detailed in tables A-1 and A-2.

b. Smaller type charcoal tubes (150 mg) may be substituted for the 600 mg tubes listed in table A-1. (Note: The 600 mg tubes are 200/400 mg two section tubes.) However, correspondingly lower air volumes and sampling rates must be used (no more than one-half of the maximum volume and one-half the maximum sampling rate listed in table A-1). This also applies to smaller silica gel tubes for aniline, cresols or methanol sampling. Chromosorb 102 33/66 mg size tube for pesticides may be interchanged with the 50/100 mg size, with no change in the recommended air volume sample being required. Size substitution for other adsorption tubes should generally not be made.

c. Generally, a number of different organic solvents can be analyzed from the same charcoal tube. Organic solvents requiring the same analytical procedure can be sampled and analyzed together. However, the following require a separate charcoal tube for each analysis requested:

- Tenax is a registered trademark of GC-Enka N.V., The Netherlands.
- Florisil is a registered trademark of Floridin Company, ITT System, Pittsburgh, PA.
- XAD-2 is a registered trademark of Rohm and Haas, Philadelphia, PA.

- (1) 2-butoxyethanol (Butyl cellosolve®)
- (2) t-butyl alcohol
- (3) carbon disulfide
- (4) 2-ethoxyethanol (ethyl cellosolve)
- (5) ethyl alcohol
- (6) ethyl ether
- (7) isopropanol
- (8) isobutyl alcohol
- (9) 2-methoxyethanol (methyl cellosolve)
- (10) methyl bromide

d. The three stage nitrogen dioxide tubes are used both for nitrogen dioxide and sulfur dioxide sampling. Both parameters can be analyzed from the same tube.

e. The capacity of charcoal tubes and passive monitors may be reduced by either--

- (1) High humidity (greater than 50 percent relative humidity) in combination with high ambient temperatures (greater than 85 °F), or
- (2) Very high humidity (greater than 80 percent relative humidity) with normal ambient temperatures.

To reduce the probability of breakthrough and sample loss, do not exceed one-half of the recommended maximum sample volume under the above conditions.

© Cellosolve is a registered trademark of Union Carbide Corp, 270 Park Ave, New York, NY.

f. The flow rate through an adsorption tube should be determined for each individual sampling pump before field use. Only one tube need be used since all tubes are packed to provide a uniform pressure drop at the prescribed flow rate. For field sampling, changes in pressure drop and thus flow rate through the adsorption tube are assumed to be negligibly affected by packing and transport.

g. Field blank tubes will be submitted with each set of samples. If the number of samples in a set exceeds 10, then submit at the rate of one blank for each 10 samples, not to exceed 10 blanks per set. The field blank should be opened and capped; no air should be drawn through it.

h. After sampling, snugly replace plastic caps on all adsorption tubes.

6. IMPINGER SAMPLING

a. Impinger sampling, as described in this guide, generally refers to the use of midjet impingers fitted with fritted bubbler nozzles. The one exception is ozone, which requires a standard nozzle with a 1 mm inside diameter opening.

b. Samples collected in glass fritted bubblers should be transferred to clean, glass-stoppered bottles with teflon lined caps. Rinse the glass fritted bubblers with a small amount of unused absorbing solution, adding the rinse to the sample. Note: Samples collected for ozone analysis should be transferred to stoppered bottles with teflon septum caps without rinsing.

c. Ground-glass surfaces and fritted bubblers used for sampling with sodium hydroxide absorbent should be thoroughly rinsed or purged with water after sampling. This prevents "freezing" or fusion of the ground-glass surfaces.

d. Reagent grade chemicals and high quality deionized or distilled water must be used in preparation of absorbing solutions.

e. One media blank of unused absorbing solution must be submitted with each set of samples.

7. BULK SAMPLING

a. Bulk sampling procedures for chemical contaminants including container type and amount of sample required are specified in table A-2.

b. When requesting an analysis for organic solvents and metals in the same sample (such as a paint), submit two portions--one for solvents and one for metals.

c. The composition of bulk "unknowns" can often be identified from the information in Material Safety Data Sheets (MSDS). Similar information on product composition may be available through the Department of Defense Hazardous Materials Information System (DOD HMIS) [DOD 6050.5L and Letter Requirement (LR)] if the National Stock Number of the item is known. For those items not in the listing, obtain the MSDS for a product from its manufacturer. If sample analysis is still required, forward the MSDS, sample, and analytical request to the appropriate supporting laboratory (app C).

8. PASSIVE (DIFFUSION TYPE) MONITORS

a. Organic solvent vapors.

(1) Passive monitors for organic solvent vapors contain an adsorbent charcoal element similar to a charcoal tube and are analyzed similarly to a charcoal tube.

(2) The passive monitors should only be used for the contaminants in table A-1 and not for collecting "unknown" organic vapors.

(3) Mixtures of several solvents may be collected only if all the solvents can be analyzed on the monitor and the sampling times are similar.

(4) Manufacturers list many solvents which can be sampled with passive monitors, however, few of these are validated procedures, and consequently are not included in this guide.

(5) A blank monitor (open bag, open monitor, then replace monitor in sample bag) is to be submitted with the field samples. Do not intentionally expose the field blank monitor to the contaminated workplace environment. Passive monitors are not recommended for ceiling or short term exposure sampling.

b. Ethylene oxide (ETO).

(1) Passive monitors for ETO manufactured by 3M[®] have been validated.

(2) Passive monitors for organic solvent vapors cannot be used for ETO.

9. RADON SAMPLING. For radon sampling procedures, call the USAEHA Health Physics Division, AUTOVON 584-3502.

10. FIELD BLANKS

a. The field blank--

(1) Detects a contaminant in the sorbent.

(2) Detects contamination in shipping and storage.

(3) Aids in determining interferences in the collection media.

(4) Serves as a reference in most spectrophotometric methods.

b. At least one field blank must be submitted with each set of impinger, filter, adsorption tube, or passive monitor samples from the same sampling series. If the number of samples in a set exceeds ten, then submit one blank for each ten samples, or fraction thereof. A set is one or more samples for the same contaminant(s).

c. Blanks should always be from the same lot as the sample tubes, filters, or monitors. If two different lot numbers are used in sampling, then two blanks are required, one from each appropriate lot number.

d. All adsorption tubes and passive monitor blanks should be treated like samples except they should be opened and resealed immediately. Do not intentionally contaminate the field blank.

[®] 3M is a registered trademark of Minnesota Mining and Manufacturing Co., St. Paul, MN.

11. PROCEDURES FOR SUBMITTING SAMPLES

a. Air samples.

(1) Complete AEHA Form 9-R (Industrial Hygiene Air Sample Data). Instructions for completing AEHA Form 9-R are in appendix D. AEHA Form 9-R is located at the back of this technical guide. Copies may be locally reproduced on 8 1/2- by 11-inch paper.

(2) The AEHA Form 9-R must accompany all IH samples submitted for air sample analysis.

(3) Field personnel should establish a consecutive numbering system for assigning sample numbers. There should be no duplication of numbers from batch to batch. Number all samples including blanks.

(4) A "blank" must accompany all air samples, be numbered, and the word "BLANK" written on the tube, filter, bottle, passive monitor, or impinger. Indicate on the form the "blank" sample number.

(5) In CONUS, samples may be forwarded directly to either: the Commander, USAEHA, ATTN: HSHB-ML-A, Bldg E2100, APG, MD 21010-5422 or to the appropriate FSA (app C). OCONUS activities can consult their supporting laboratory (app C) for sample analysis.

b. Bulk samples.

(1) Complete AEHA Form 8-R (Bulk Sample Data). Instructions for completing AEHA Form 8-R are in appendix E. AEHA Form 8-R is located at the back of this technical guide. Copies may be locally reproduced on 8 1/2- by 11-inch paper.

(2) The AEHA Form 8-R must accompany all IH samples submitted for bulk analysis.

(3) Include the manufacturer's label information and attach the manufacturer's MSDS when possible.

(4) In CONUS, samples may be forwarded directly to either: the Commander, USAEHA, ATTN: HSHB-ML-A, Bldg E2100, APG, MD 21010-5422 or to the appropriate FSA (app C). OCONUS activities may consult their supporting laboratory (app C) for sample analysis.



Technical No. 141

March 1987

Appendix A

Tables



A-1



Table A-1
Air sampling procedures for chemical contaminants

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAHA APG procedure number
			minimum	maximum	
Acetic acid	Chromosorb tube for acids (ORBO 70 acid tube)	100-500 mL/min	15	60	(1)
Acetone	200/400 mg charcoal tube	20-100 mL/min	1	6	(2)
Acid mists	See specific acid				
Alkali mists (such as NaOH, KOH)	See specific compound				
Aluminum	Filter cassette, closed-face (CE 0.8 μ m filter)	1-3 L/min	100	400	(3)
Ammonia	Ammonia tube (ORBO 77)	100-500 mL/min	3	24	(4)
Amyl acetate (all isomers)	200/400 mg charcoal tube	20-500 mL/min	5	40	(5)
Aniline	260/520 mg silica-gel tube	200-500 mL/min	25	60	(6)
Antimony compounds	Filter cassette, closed-face (CE 0.8 μ m filter)	1-2 L/min	100	1000	(7)
Arsine	200/400 mg charcoal tube	10-20 mL/min	1	10	(8)
Asbestos	25 mm filter cassette, open-face shrouded with 50 mm extension cowl (CE 0.8 to 1.2 μ m filter) See paragraph 2a	0.5-2.5 L/min	360	2000	(9)
NOTE: For monitoring asbestos following abatement actions, sample at 1 to 5 L/min for a sample volume between 1300 and 3000 liters.					
Azide	See Hydrazoic acid				
Barium compounds	Filter cassette, closed-face (CE 0.8 μ m filter)	1-2 L/min	300	1000	(10)
Benzene	200/400 mg charcoal tube	50-500 mL/min	25	40	(11)
Beryllium	Filter cassette, closed-face with spacer (CE 0.8 μ m filter)	1-4 L/min	250	1000	(12)

Chromosorb is a registered trademark of Johns-Manville Products Corp., Denver, CO.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters minimum maximum	USAHA APG procedure number
2-Butoxyethanol (Ethylene glycol monobutyl ether)	200/400 mg charcoal tube (Refrigerate after sampling)	50-500 mL/min	10 40	(13)
n-Butyl acetate	200/400 mg charcoal tube	50-200 mL/min	5 30	(5)
n-Butyl alcohol	200/400 mg charcoal tube	200 mL/min only (ceiling)	3.0 L only	(14)
tert-Butyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	50-200 mL/min	2 20	(15)
Cadmium	Filter cassette, closed-face (CE 0.8 μ m filter)	1-3 L/min	100 1500	(16)
Carbon disulfide	200/400 mg charcoal tube	50-200 mL/min	4 40	(17)
Carbon tetrachloride	200/400 mg charcoal tube	50-500 mL/min	25 40	(18)
Chlordane (chlordane constituents)	50/100 mg Chromosorb 102 Tube	1-2 L/min	300 500	(19)
*Chlorpyrifos (Dursban®)	33/66 mg Chromosorb 102 Tube	1-2 L/min	30 50	(20)
Chlorobenzene	200/400 mg charcoal tube	50-250 mL/min	10 40	(18)
Chloroform	200/400 mg charcoal tube	5-500 mL/min	25 40	(18)
Chromic acid mist and Chromium VI	Filter cassette, closed-face (PVC 5.0 μ m filter) See paragraph 4f. Submit three blank filters	1-4 L/min	100 400	(21)
Chromium (as dust or fume)	Filter cassette, closed-face (CE 0.8 μ m filter)	1-3 L/min	100 1000	(22)
Copper	Filter cassette, closed-face (CE 0.8 μ m filter)	1-3 L/min	60 1500	(23)
Cresols	260/520 mg silica gel tube	50-500 mL/min	25 40	(24)

* Dursban is a registered trademark of Dow Chemical Co., Midland, MI.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAHA APG procedure number
			minimum	maximum	
**Cyanide	Midget impinger (10 mL of 0.2 N sodium hydroxide) (Transfer to a plastic bottle after collection.)	1.5 L/min	20	90	(28)
Cyclohexanone	200/400 mg charcoal tube	50-500 mL/min	7.5	30	(2)
*Diazinon	33/66 mg Chromosorb 102 Tube	1-2 L/min	30	50	(20)
Dichlorobenzene, ortho	200/400 mg charcoal tube	500 mL/min only (ceiling)	7.5 L only		(18)
Dichlorobenzene, para	200/400 mg charcoal tube	100-500 mL/min	7.5	40	(18)
Dichlorodifluoromethane (Freon® 12)	200/400 mg charcoal tube (2 tubes in series)	30-200 mL/min	0.5	5	(26)
Dieldrin (dust only)	Filter cassette, closed-face (GF 37 mm)	1.5 L/min	160	200	(27)
*Diesel fuel	(see Fuel oil #2)				
1,1 Dimethylhydrazine	Hydrazine tube [45-60 mesh activated silica gel treated with 20% (by weight) conc H ₂ SO ₄]	200-500 mL/min	35	100	(28)
Diethylphthalate (DDP, Di-2-ethylhexylphthalate)	Filter cassette, closed-face with spacer (CE 0.8 µm filter)	1.0 L/min	30 TWA 15 peak	120	(29)
Dicxane	200/400 mg charcoal tube	50-500 mL/min	7.5	40	(30)
*Dust (total)	Filter cassette, closed-face (PVC 5.0 µm filter preweighed) (Lower volumes may be necessary in very dusty locations where filters may clog.)	1-2 L/min	400	1000	(31)
*Dust (respirable)	Filter cassette, with cyclone (PVC 5.0 µm filter preweighed)	1.7 L/min only	500	816	(31)
Endrin	33/66 mg Chromosorb 102 tube	1-2 L/min	30	50	(32)

® Freon is a registered trademark of E. I. DuPont de Nemours and Co., Wilmington, DE.

Chemical contaminant	Sampling method or	Sampling rate or time	Sample volume in liters		USAHA APG procedure number
			minimum	maximum	
Enflurane (Ethrane®)	200/400 charcoal tube or Passive monitor	25-500 mL/min 1.0-8.0 hr	5	20	(33)
Epichlorohydrin	200/400 mg charcoal tube	20-200 mL/min	10	40	(34)
2-Ethoxyethanol (Ethylene glycol monoethyl ether, Cellosolve)	200/400 mg charcoal tube (Refrigerate after sampling)	100-500 mL/min	25	40	(13)
2-Ethoxyethyl acetate (cellosolve acetate)	200/400 mg charcoal tube	100-500 mL/min	25	40	(5)
Ethyl acetate	200/400 mg charcoal tube	20-500 mL/min	2	20	(35)
Ethyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	20-50 mL/min	0.5	2	(15)
Ethyl cellosolve	See 2-Ethoxyethanol				
Ethylene dichloride (1,2-Dichloroethane)	200/400 mg charcoal tube	50-500 mL/min	7.5	20	(18)
Ethylene glycol dinitrate (EGDN)	50/100 mg Tenax tube	0.2-1 L/min	15	100	(36)
Ethylene oxide (ETO)	ORBO 78 ETO tube or 3M Passive monitor for ETO	20-200 mL/min 8 hr	9.6	20	(37)
Ethyl ether	200/400 mg charcoal tube	50-100 mL/min	1	6	(38)
					(39)

® Ethrane is a registered trademark of Ohio Medical Products, a Division of Airco, Inc., Madison, Wisconsin 53701.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters minimum maximum	USAEHA APG procedure number
"Fibrous glass dust	Filter cassette, closed-face (PVC 5.0 µm preweighed filter). Quantitative analysis performed gravimetrically; fiber identification can be confirmed qualitatively by microscope upon request. Fibrous glass samples will not be counted microscopically.	1-2 L/min	400 1000	(31)
"Fluorides (Aerosol and gas)	Filter cassette, closed-face with CE 0.8 µm filter, backed up with filter cassette, closed-face with Na ₂ CO ₃ -treated cellulose pad. Connect cassette with PVC tubing.	1-2 L/min	20 800	(40)
"Forane	200/400 mg charcoal tube	25-500 mL/min	5 20	(18)
"Formaldehyde	50/100 mg formaldehyde tube (Refrigerate after sampling)	20-50 mL/min	9.6 24	(41)
Formic acid	DRBO 70 acid tube	100-500 mL/min	15 60	(1)
Freon 11	See Trichlorofluoromethane			
Freon 12	See Dichlorodifluoromethane			
Freon 113	See Trichlorotrifluoroethane			
"Fuel oil #2	200/400 mg charcoal tube	50-500 mL/min	10 40	(201)
"Gasoline	200/400 mg charcoal tube	50-500 mL/min	7.5 20	(201)
Halothane	200/400 mg charcoal tube or Passive monitor	25-500 mL/min	5 20	(33)
Hexachloroethane	200/400 mg charcoal tube	50-200 mL/min	10 40	(18)
Hexane	200/400 mg charcoal tube	50-500 mL/min	6 40	(42)
Hexamethylene diisocyanate (HDI)	Widgit impinger (10 mL of HCl - acetic absorbent) Absorbent preparation: 3.5 mL concentrated HCl and 2.2 mL acetic acid diluted to 100 mL with distilled or deionized water.	1-2 L/min	30 60	(45)

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAHA APG procedure number
			minimum	maximum	
Hydrazine	Hydrazine tube (45-60 mesh activated silica treated with 20% (by weight) conc H ₂ SO ₄)	200-500 mL/min	35	100	(28)
Hydrazoic acid (Hydrogen azide)	ORBO 70 tube for acids	2 L/min only (ceiling)	30 L only	-	(1)
Hydrochloric acid	200/400 high purity silica gel tube (Inorganic acids tube)	200 mL/min only (ceiling)	3.0 L only	-	(44)
	ORBO 70 tube for acids or See Hydrogen fluoride	500 mL/min only (ceiling)	7.5 L only	-	
Hydrofluoric acid	See Hydrogen fluoride				
**Hydrogen cyanide	Midget impinger (10 mL of 0.2 N sodium hydroxide) (transfer to a plastic bottle after collection.)	1.5 L/min only (ceiling)	22.5 L only	-	(25)
Hydrogen fluoride	200/400 mg high purity silica gel tube (Inorganic acids tube)	2.5 L/min only (ceiling)	37.5 L only	-	(44)
Hydroquinone	Filter cassette, closed-face (CE 0.8 µm filter). Transfer filter immediately after sampling to glass vial containing 10 mL 1 percent acetic acid.	1-3 L/min	30	180	(45)
Iron	Filter cassette, closed-face (CE 0.8 µm filter)	1-2 L/min	15	500	(10)
Isobutyl acetate	200/400 mg charcoal tube	50-500 mL/min	5	40	(5)
Isobutyl alcohol	200/400 mg charcoal tube	50-500 mL/min	15	40	(14)
Isopropyl alcohol	200/400 mg charcoal tube (Refrigerate after sampling)	50-200 mL/min	2	12	(15)
*JP-4	200/400 mg charcoal tube	50-500 mL/min	7.5	20	(201)
*Kerosene	200/400 mg charcoal tube	50-500 mL/min	10	40	(201)
Lead, inorganic (fumes and dust)	Filter cassette, closed-face (CE 0.8 µm filter)	1-4 L/min	200	1200	(46)

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Lead chromate	See lead, inorganic				
Manganese	Filter cassette, closed-face (CE 0.8 μ m filter)	1-2 L/min	50	500	(10)
Mercury vapor	Mercury vapor detector				
2-Methoxyethanol (Methyl Cellosolve, Ethylene glycol monomethyl ether)	200/400 mg charcoal tube (Refrigerate after sampling)	100-500 mL/min	25	40	(13)
Methyl alcohol	260/520 mg silica gel tube	20-200 mL/min	1	5	(47)
Methyl bromide	200/400 mg charcoal tube (petroleum base) - two tubes in series	50-200 mL/min	9	20	(48)
Methyl chloroform (1,1,1-Trichloro- ethane)	200/400 mg charcoal tube or Passive monitor	20-500 mL/min 1-4 hr	1 -	20 -	(18) (200)
Methylenebis(phenyl)- isocyanate (MDI)	Widgit impinger (10 mL of HCl - acetic acid absorbent). See Hexamethylene diisocyanate for absorbent preparation.	1-2 L/min only	30	60	(49)
Methylene chloride	200/400 mg charcoal tube	20-200 mL/min	1	12	(50)
Methyl ethyl ketone (MEK)	260/520-silica gel tube	50-500 mL/min	5	20	(51)
Methyl isobutyl ketone (MIBK)	200/400 mg charcoal tube	20-250 mL/min	1	20	(2)
Methyl methacrylate	200/400 mg XAD-2 tube	20-100 mL/min	3	6	(52)
Mineral spirits	200/400 mg charcoal tube	50-500 mL/min	5	40	(53)
Molybdenum	Filter cassette, closed-face (CE 0.8 μ m filter)	1-4 L/min	5	60	(54)
Naphthalene	200/400 mg charcoal tube	200-500 mL/min	25	40	(11)

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAENH APG procedure number
			Minimum	Maximum	
Nickel, soluble compounds	Filter cassette, closed-face (CE 0.8 µm filter)	1-2 L/min	100	1000	(10)
Nickel, metal	Filter cassette, closed-face (CE 0.8 µm filter)	1-2 L/min	100	1000	(10)
Nitric acid	200/400 high purity silica gel tube (Inorganic acid tube)	200-500 mL/min	12	48	(44)
Nitrogen dioxide	Preferred: Direct reading NO ₂ meter or 400/600/400 mg nitrogen dioxide tube (ORBO 76)	20-50 mL/min	2 TWA 0.75 peak	4	(55)
Nitroglycerin	50/100 mg Tenax tube	0.2-1 L/min	15	100	(36)
N-Nitrosodimethylamine	Thermosorb/N air sampler (Refrigerate after sampling)	0.2-2 L/min	75 Liters recommended		(56)
Nitrous oxide	Portable infrared analyzer (e.g. MIRAN®)				(57)
"Nuisance particulates"	Filter cassette, closed-face (PVC, 5µm filter preweighed)	1-2 L/min	400	1000	(31)
"Oil mist"	Filter cassette, closed-face (preweighed/PVC 5.0 µm filter). Analysis performed gravimetrically.	1-2 L/min	400	1000	(31)
Ozone	Preferred: Ozone Meter (Direct reading) Alternate: All glass midget impinger (10 mL of alkaline KI). Samples of ozone should be transferred to stoppered bottles with Teflon® lined caps, without rinsing.	1-2 L/min	60	120	(58)
Pentachlorophenol	Filter cassette, closed-face with spacer (CE 0.8 µm filter) Followed by midget impinger (15 mL of ethylene glycol - Note: Do not use antifreeze in place of ethylene glycol). Ship filter, backing pad, and impinger solution combined in a glass vial with Teflon lined cap.	1.5 L/min	90	180	(59)

© Miran is a registered trademark of Foxboro Analytical, South Norwalk, CT.
 © Teflon is a registered trademark of E. I. DuPont de Nemours & Co., Inc., Wilmington, DE.

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAHA APC procedure number
			minimum	maximum	
Pentane	200/400 mg charcoal tube	10-50 mL/min	2	4	(42)
Perchloroethylene (Tetrachloroethylene)	200/400 mg charcoal tube or Passive monitor	50-500 mL/min 1-8 hr	5 TWA 2.5 peak	30	(60) (200)
Petroleum Distillate	200/400 mg charcoal tube	50-500 mL/min	5	40	(53)
Phenol	260/520 silica gel tube	50 mL/min	3	20	(61)
Phosphoric acid	200/400 mg high purity silica gel tube (Inorganic acids tube)	200-500 mL/min	30	120	(44)
*Polychlorinated biphenyls (PCBs)	50/100 mg Florisil tube preceded by 13 mm glass fiber filter in Swinex cassette	50-200 mL/min	12	48	(62)
*Polynuclear Aromatic Hydrocarbons (PAH)	ORBO 43 tube preceded by 37 mm cassette containing PIFE 2 µm filter	2 L/min	200	1000	(63)
*Potassium hydroxide	Filter cassette, closed-face (CE 0.8 µm filter) Submit three blank filters.	1-2 L/min	60	480	(64)
n-propyl alcohol	200/400 mg charcoal tube	50-200 mL/min	2	20	(14)
Propylene dichloride (1,2 Dichloropropane)	200/400 mg charcoal tube	50-500 mL/min	5	30	(18)
Quartz (crystalline silica)	See silica, crystalline (respirable)				
Radon	Call USAEHA, Health Physics Division, AUTOVON 584-3502				
PDX (cyclonite)	50/100 mg Tenax tube	1 L/min	15	50	(65)
Silica, crystalline (respirable)	Filter cassette, closed-face and 10 mm nylon cyclone (PVC 5 µm filter) See paragraph 3a.	1.7 L/min only	500	816	(66)

Chemical contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APG procedure number
			minimum	maximum	
Sodium azide	See hydrazoic acid				
*Sodium hydroxide	Filter cassette, closed-face (CE 0.8 µm filter) Submit three blank filters.	1-2 L/min	60	480	(64)
Stoddard solvent	200/400 mg charcoal tube	50-500 mL/min	5	40	(53)
Styrene	200/400 mg charcoal tube	50-500 mL/min	5	40	(11)
Sulfur dioxide	400/600/400 mg Nitrogen dioxide tube (OREJ-76)	20-50 mL/min	2	12	(55)
Sulfuric acid	200/400 mg high purity silica gel tube (Inorganic acids tube)	200-500 mL/min	24	48	(44)
Tetrahydrofuran	200/400 mg charcoal tube	50-250 mL/min	5	24	(67)
*Titanium Dioxide	Filter cassette, closed-face preweighed (PVC, 5.0 µm filter)	1-2 L/min	400	1000	(31)
Toluene	200/400 mg charcoal tube	50-500 mL/min	5	40	(11)
Toluene diisocyanate (TDI)	Midget impinger (10 mL of HCl - acetic absorbent) See Hexamethylene diisocyanate for absorbent preparation.	1-2 L/min	30	60	(49)
Trichloroethylene	200/400 mg charcoal tube or Passive monitor	50-500 mL/min 1-8 hr	5	40	(68) (200)
Trichlorofluoromethane (Freon 11)	200/400 mg charcoal tube	50 mL/min only (ceiling)	0.75 L only	-	(69)
Trichlorotrifluoro- ethane (Freon 113)	200/400 mg charcoal tube	20-50 mL/min	0.5	5	(70)
Trinitrotoluene (TNT)	50/100 mg Tenax tube 50/100 mg Tenax with filter (custom OREJ-79)	1 L/min	15	50	(65)
Welding fumes (Total fumes)	Filter, closed-face (PVC 5.0 µm preweighed filter)	1-2 L/min	400	1000	(31)

Chemical Contaminant	Sampling method	Sampling rate or time	Sample volume in liters		USAEHA APC procedure number
			minimum	maximum	
Welding fumes (metals)	For metal analysis see specific metal.				
White phosphorus (yellow phosphorus)	50/100 mg Tenax tube	200 mL/min	12	12	(71)
Xylenes	200/400 mg charcoal tube	50-500 mL/min	5	40	(11)
Zinc Compounds	Filter cassette, closed-face (CE 0.8 µm filter) Submit three blank filters.	1-3 L/min	15	400	(72)

* Methods included in this Table as "Stopgap Methods" - procedures which are not fully validated.

**Indicates the following alternate procedures are used by FSA-FAMC:

Ammonia	100/200 mg Sulfuric Acid treated silica gel tube	100-200 mL/min	15	70	--
Cyanide	Filter cassette (CE 0.8 µm filter) followed by midjet impinger with 10 mL of 0.1N KOH solution	0.5-1.0 L/min	10	180	--
Formaldehyde	1650/1650 alumina tube	200 mL/min	4	10	--
Hydrogen Cyanide	See cyanide	--	--	--	--

Table A-2
Bulk sampling procedures for chemical contaminants

Chemical contaminant	Container requirements	Sample size
Asbestos	Screw cap; glass or plastic vial. Plastic bags are not acceptable.	1/2 inch x 1/2 inch section
Corrosive (acidic or basic)	All glass (for acids only) or polyethylene (for acids and bases).	100 mL (unused material preferred)
Lead or chromium in paint	Screw cap; plastic container.	20-50 mL
Lead in paint chips	Screw cap; glass or plastic container, or plastic envelope	1 gram (A dime weighs about 2 grams.) Do not submit plaster or other backing materials.
Organic solvents including paints	All glass container, or glass container with Teflon-lined screw cap, or all metal can. Do not use plastic or paper lined caps.	100 mL (unused material preferred)
Pentachlorophenol in wood	Wrap in aluminum foil.	2 inch x 2 inch sections. Do not submit sawdust.
Polychlorinated biphenyls (PCBs)	Glass container with Teflon-lined screw cap.	1-2 mL

Table A 3
Documentation of IH air sampling procedures

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APC procedure number
acetic acid	ORBO-70 tube	Ion chromatography	7.0%	AIMA J. 42(6):476-8 (1981)	(1)
acetone	Charcoal tube	Gas chromatography, FID	8.2%	NIOSH: 1300 (3rd Ed.)	(2)
aluminum	CE filter	Atomic absorption, flame	5.8%	NIOSH: 7013 (3rd Ed.)	(3)
ammonia	Ammonia tube (ORBO-77) Sulfuric acid treated silica gel tube	Ion chromatography Ion specific electrode	8.4% 8.0%	AIMA J. 47(2):135-137 (1986) NIOSH: 5347 (Vol 5, 2nd Ed.)	(4) --
butyl acetate	Charcoal tube	Gas chromatography, FID	5.1%	NIOSH: 1450 (3rd Ed.)	(5)
butylene	Silica gel tube	Gas chromatography, FID	6.6%	NIOSH: 2002 (3rd Ed.)	(6)
carbonyl compounds	CE filter	Atomic absorption, flame	5.9%	NIOSH: S2 (Vol. 2, 2nd Ed.)	(7)
cresol	Charcoal tube	Atomic absorption, graphite furnace	8.7%	NIOSH: 6001 (3rd Ed.)	(8)
cyclohexane	CE filter	Microscope, counting	25%	NIOSH: 7400 (3rd Ed.) Federal Register, Vol. 51, No. 119, EPA 560/5-85-024	(9)
barium compounds	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
benzene	Charcoal tube	Gas chromatography, FID	5.9% CT	NIOSH: 1501 (3rd Ed.)	(11)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Beryllium	CE filter	Atomic absorption, graphite furnace	6.4%	NIOSH: 7102 (3rd Ed.)	(12)
2-Butoxyethanol	Charcoal tube	Gas chromatography, FID	6.0%	NIOSH: 1403 (3rd Ed.)	(13)
n-Butyl acetate	Charcoal tube	Gas chromatography, FID	6.9%	NIOSH: 1450 (3rd Ed.)	(5)
n-Butyl alcohol	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1401 (3rd Ed.)	(14)
i-Butyl alcohol	Charcoal tube	Gas chromatography, FID	7.5%	NIOSH: 1400 (3rd Ed.)	(15)
Carbon monoxide	CE filter	Atomic absorption, flame	6.0%	NIOSH: 7048 (3rd Ed.)	(16)
Carbon disulfide	Charcoal tube	Gas chromatography, FID	5.9%	NIOSH: 1600 (3rd Ed.)	(17)
Carbon tetrachloride	Charcoal tube	Gas chromatography, FID	9.2%	NIOSH: 1003 (3rd Ed.)	(18)
Chlordane (chlordane constituents)	Chromosorb 102 tube	Gas chromatography, ECD	7.0%	NIOSH: S278 (Vol. 6, 2nd Ed.)	(19)
Chlorpyrifos (Dursban)	Chromosorb 102 tube	Gas chromatography, FPD	NV	Bulletin Environ. Contam. Toxicol (1984) 33:476-483	(20)
Chlorobenzene	Charcoal tube	Gas chromatography, FID	5.6%	NIOSH: 1003 (3rd Ed.)	(18)
Chloroform	Charcoal tube	Gas chromatography, FID	5.7%	NIOSH: 1003 (3rd Ed.)	(18)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Chromic acid mist and Chromium VI	PVC filter	Spectrophotometry, visible	8.4%	NIOSH: 7600 (3rd Ed.)	(21)
Chromium (as dust or fume)	CE filter	Atomic absorption, flame	7.6% (Insol.) 8.5% (Sol.)	NIOSH: 7024 (3rd Ed.)	(22)
Copper	CE filter	Atomic absorption, flame	4.4% (Fume) 5.1% (Dust)	NIOSH: 7029 (3rd Ed.)	(23)
Cresols	Silica gel tube	Gas chromatography, FID	6.8%	NIOSH: 2001 (3rd Ed.)	(24)
Amide	Widget impinger with NaOH CE filter plus impinger with KOH	Ion chromatography Ion specific electrode	4.8% 8.1%	ASTM: STP 786 (1982:142-152) NIOSH: 7904 (3rd Ed.)	(25) --
Hexanone	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1300 (3rd Ed.)	(2)
Diazinon	Chromosorb 102 tube	Gas chromatography, FPD	NV	Bulletin Environ. Contam. Toxicol (1984) 33:476-483	(20)
Dichlorobenzene, ortho	Charcoal tube	Gas chromatography, FID	6.7%	NIOSH: 1003 (3rd Ed.)	(18)
Dichlorobenzene, para	Charcoal tube	Gas chromatography, FID	5.2%	NIOSH: 1003 (3rd Ed.)	(18)
Dichlorodifluoromethane (Freon 12)	Charcoal tube	Gas chromatography, FID	6.4%	NIOSH: S111 (Vol. 2, 2nd Ed.)	(26)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAFA APC procedure number
Dieldrin (dust)	GF filter	Gas chromatography, ECD	8.6%	NIOSH: S283 (Vol. 3, 2nd Ed.)	(27)
1 Dimethylhydrazine	Hydrazine tube	Gas chromatography, FID	4.0%	NIOSH: 248 (Vol. 1, 2nd Ed.)	(28)
Diethylphthalate (DEP, Diethylhexylphthalate)	CE filter	Gas chromatography, FID	5.7%	NIOSH: S40 (Vol. 2, 2nd Ed.)	(29)
Dioxane	Charcoal tube	Gas chromatography, FID	5.4%	NIOSH: S360 (Vol. 3, 2nd Ed.)	(30)
Dust (total)	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Dust (respirable)	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Endrin	Chromosorb 102 tube	Gas chromatography, ECD	7.1%	NIOSH: S284 (Vol. 6, 2nd Ed.)	(32)
Enflurane (Ethrane)	Charcoal tube or Passive monitor	Gas chromatography, FID	8.9% (CT) 4.9% (PM)	AIMA J. 41(5):317-321 (1980)	(33)
Epichlorohydrin	Charcoal tube	Gas chromatography, FID	5.2%	NIOSH: 1010 (3rd Ed.)	(34)
2 Ethoxyethanol (Ethylene glycol monoethyl ether, Cellosolve	Charcoal tube	Gas chromatography, FID	5.9%	NIOSH: 1403 (3rd Ed.)	(13)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APC procedure number
Ethoxyethyl acetate (cellulosolve acetate)	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1450 (3rd Ed.)	(5)
Ethyl acetate	Charcoal tube	Gas chromatography, FID	5.8%	NIOSH: 549 (Vol. 2, 2nd Ed.)	(35)
Ethyl alcohol	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1400 (3rd Ed.)	(18)
Ethylene dichloride 1,2 Dichloroethane	Charcoal tube	Gas chromatography, FID	7.9%	NIOSH: 1003 (3rd Ed.)	(18)
Ethylene glycol dinitrate	Tenax tube	Gas chromatography, ECD	8.9%	NIOSH: 2507 (3rd Ed.)	(36)
Ethylene oxide (ETO)	ORBO 78 or 3M Passive monitor for ETO	Gas chromatography, FID	3.5% 4.3%	ANAL. CHEM. 56:1950-3 (1984) ATMA J. 46(10):625-631 (1985)	(37) (38)
Ethyl ether	Charcoal tube	Gas chromatography, FID	5.3%	NIOSH: 1610 (3rd Ed.)	(39)
Fibrous glass dust	Preweighed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Fluorides	CE filter plus Na ₂ CO ₃ treated filter	Ion chromatography	NV	NIOSH: 7903/7902 (3rd Ed.)	(40)
Forane	Charcoal tube	Gas chromatography, FID	NV	Inhouse procedure based on NIOSH: 1003 (3rd Ed.)	(18)
Formaldehyde	Formaldehyde tube Alumina tube	Ion chromatography Spectrophotometry, visible	9.7% 7.8%	NIOSH: 318 (Vol. 6, 2nd Ed.) NIOSH: 235 (Vol. 1, 2nd Ed.)	(41) --

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAEHA APG procedure number
Formic acid	OR80 70 Acid tube	Ion chromatography	NV	AIHA J. 42(6):476-8 (1981)	(1)
Fuel oil #2	Charcoal tube	Gas chromatography, FID	NV	Inhouse procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Gasoline	Charcoal tube	Gas chromatography, FID	NV	Inhouse procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Halothane	Charcoal tube or Passive monitor	Gas chromatography, FID	6.4% (CT) 8.4% (PM)	AIHA J. 41(5):317-21 (1980)	(33)
Hexachloroethane	Charcoal tube	Gas chromatography, FID	12.1%	NIOSH: 1003 (3rd Ed.)	(18)
Hexane	Charcoal tube	Gas chromatography, FID	6.2%	NIOSH: 1500 (3rd Ed.)	(42)
Hexamethylene diisocyanate (MDI)	Midget impinger (10 mL of HCl - acetic acid absorbent)	Gas chromatography, ECD	9.1%	ANAL. CHEM. 54:1572-5 (1982)	(43)
Hydrazine	Hydrazine tube	Gas chromatography, FID	4.6%	NIOSH: 248 (Vol. 1, 2nd Ed.)	(28)
Hydrozoic acid (hydrogen azide)	OR80 70 tube	Ion chromatography	7.3%	AIHA J. 42(6):476-8 (1981)	(1)
Hydrochloric acid	High purity silica gel tube or OR80 70 tube for acids	Ion chromatography	5.9% 7.1%	NIOSH: 7903 (3rd Ed.) or AIHA J. 42(6):476-8 (1981)	(44) (1)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAFA APG procedure number
Hydrogen cyanide	Midget impinger with NaOH CE filter plus impinger with KOH	Ion chromatography Ion specific electrode	4.0% 8.1%	ASTM: STP 786 (1982:142-152) NIOSH: 7904 (3rd Ed.)	(25) --
Hydrogen fluoride	High purity silica gel tube	Ion chromatography	11.6%	NIOSH: 7903 (3rd Ed.)	(44)
Hydroquinone	CE filter	Liquid chromatography	6.1%	NIOSH: 5004 (3rd Ed.)	(45)
Iron	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
Isobutyl acetate	Charcoal tube	Gas chromatography, FID	6.5%	NIOSH: 1450 (3rd Ed.)	(5)
1-butyl alcohol	Charcoal tube	Gas chromatography, FID	7.3%	NIOSH: 1401 (3rd Ed.)	(14)
Isopropyl alcohol	Charcoal tube	Gas chromatography, FID	6.4%	NIOSH: 1400 (3rd Ed.)	(15)
JP-4	Charcoal tube	Gas chromatography, FID	NV	Inhouse procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Kerosene	Charcoal tube	Gas chromatography, FID	NV	Inhouse procedure based on NIOSH: 1550 (3rd Ed.)	(201)
Lead, inorganic (fumes and dust)	CE filter	Atomic absorption, flame	7.2%	NIOSH: 7082 (3rd Ed.)	(46)
Manganese	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)

Chemical Contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Mercury vapor	Mercury vapor detector	See Manufacturer's Literature			
Methoxyethanol (Methyl cellosolve, Ethylene glycol monomethyl ether)	Charcoal tube	Gas chromatography, FID	6.8%	NIOSH: 1403 (3rd Ed.)	(13)
Methyl alcohol	Silica gel tube	Gas chromatography, FID	6.3%	NIOSH: 2000 (3rd Ed.)	(47)
Methyl bromide	Charcoal tube (Petroleum base)	Gas chromatography, FID	10.3%	NIOSH: 2520 (3rd Ed.)	(48)
Methyl chloroform 1,1,1-Trichloroethane	Charcoal tube or Passive monitor	Gas chromatography, FID	5.4% (CT) 4.7% (PM)	NIOSH: 1003 (3rd Ed.) or AIHA J. 42(10):752-6 (1981)	(18) (200)
Methylenebis(phenyl- isocyanate) (MDI)	Midget impinger (10 mL of HCl - acetic acid absorbent)	Gas chromatography, ECD	5.3%	AIHA J. 43(3):151-5 (1983)	(49)
Methylene chloride	Charcoal tube	Gas chromatography, FID	7.3%	NIOSH: 1005 (3rd Ed.)	(50)
Methyl ethyl ketone	Silica gel tube	Gas chromatography, FID	4.0%	AIHA J. 44(3):201-204 (1983)	(51)
Methyl isobutyl ketone (MIBK)	Charcoal tube	Gas chromatography, FID	6.4%	NIOSH: 1300 (3rd Ed.)	(2)
Methyl methacrylate	XAD-2 tube	Gas chromatography, FID	6.3%	NIOSH: S43 (Vol. 6, 2nd Ed.)	(52)
Mineral spirits	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(53)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Molybdenum	CE filter	Atomic absorption, flame or ICP	4.9%	NIOSH: 7300 (3rd Ed.)	(84)
Naphthalene	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: 1501 (Vol. 3, 2nd Ed.)	(11)
Nickel, soluble compounds	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
Nickel, metal	CE filter	Atomic absorption, flame	5.8%	NIOSH: 173 (Vol. 5, 2nd Ed.)	(10)
Nitric acid	High purity silica gel tube	Ion chromatography	8.5%	NIOSH: 7903 (3rd Ed.)	(44)
Nitrogen dioxide	Direct reading NO ₂ meter or nitrogen dioxide tube	Electrochemical sensor Ion chromatography	- 9.2%	Metier: See Manufacturer's Literature ANAL. CHEM. 53:1689-1691 (1981)	(55)
Nitroglycerin	Tenax tube	Gas chromatography, ECD	10.4%	NIOSH: 2507 (3rd Ed.)	(36)
Nitrosodimethylamine	Thermosorb/W Sampler	Gas chromatography	3.7%	OSHA: Method No. 27	(56)
Nitrous oxide	Portable infrared analyzer (e.g., MIRAN)			NIOSH: 6600 (3rd Ed.) See Manufacturer's Literature	(57)
Nuisance particulates	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)
Oil mist	Prewieghed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APC procedure number
Ozone	Preferred: Ozone Meter (Direct reading) Alternate: Midget impinger (10 mL of alkaline KI)	Spectrophotometry, visible	8.8%	See Manufacturer's Literature NIOSH: 154 (Vol. 1, 2nd Ed.)	(58)
PentachlorophenoI	CE filter with midget impinger (15 mL of ethylene glycol)	High performance liquid chromatography, UV	7.2%	NIOSH: S297 (Vol. 4, 2nd Ed.)	(59)
Pentane	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: 1500 (3rd Ed.)	(62)
Perchloroethylene (Tetrachloroethylene)	Charcoal tube or Passive monitor	Gas chromatography, FID	5.2% (CI) 5.6% (PM)	NIOSH: S335 (Vol. 3, 2nd Ed.) or AIMA J. 43(4):227-34 (1982)	(60) (200)
Petroleum distillates	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(63)
Phenol	Silica gel tube	Gas chromatography, FID	7.7%	Presentation #176, 1984 AIMA conference	(61)
Phosphoric acid	High purity silica gel tube	Gas chromatography, FID	9.6%	NIOSH: 7903 (3rd Ed.)	(46)
Polychlorinated biphenyls (PCB)	Florisil tube plus glass fiber filter	Gas chromatography, ECD	NV	NIOSH: 5503 (3rd Ed.)	(62)
Polynuclear Aromatic Hydrocarbons (PAH)	ORBO 43 tube and PTFE filter in series	High performance liquid chromatography, UV and fluorescence or Gas chromatography, FID	NV	NIOSH: 5506 (3rd Ed.) or 5515 (3rd Ed.)	(63)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Potassium hydroxide	CE filter	Atomic absorption, flame	NV	NIOSH Publication No. 76-105	(64)
Propylene dichloride (1,2 Dichloropropane)	Charcoal tube	Gas chromatography, FID	5.6%	NIOSH: 1003 (3rd Ed.)	(18)
n Propyl alcohol	Charcoal tube	Gas chromatography, FID	7.5%	NIOSH: 1401 (3rd Ed.)	(14)
ROX (Cyclonite)	Tenax tube	Gas chromatography, ECO	6.7%	AIHA J. 42(8):586-9 (1981)	(65)
Silica, crystalline (Respirable)	PVC filter	X-ray diffraction	9.0%	NIOSH: 7500 (3rd Ed.)	(66)
Sodium hydroxide	CE filter	Atomic absorption, flame	NV	NIOSH Publication No. 76-105	(64)
Standard solvent	Charcoal tube	Gas chromatography, FID	5.0%	NIOSH: 1550 (3rd Ed.)	(53)
Toluene	Charcoal tube	Gas chromatography, FID	5.8%	NIOSH: 1501 (3rd Ed.)	(11)
Sulfur dioxide	Nitrogen dioxide tube	Ion chromatography	9.4%	ANAL. CHEM. 53:1689-1691 (1981)	(55)
Sulfuric acid	High purity silica gel tube	Ion chromatography	8.7%	NIOSH: 7903 (3rd Ed.)	(44)
Tetrahydrofuran	Charcoal tube	Gas chromatography, FID	5.5%	NIOSH: 578 (Vol. 2, 2nd Ed.)	(67)
Titanium dioxide	Preweighed PVC filter	Gravimetric, Anal. balance	NV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)

Chemical contaminant	Sampling method	Analytical method	Coefficient of variation	Reference	USAHA APG procedure number
Toluene	Charcoal tube	Gas chromatography, FID	5.2%	NIOSH: 1501 (3rd Ed.)	(11)
Toluene diisocyanate (TDI)	Midgel impinger (10 mL of HCl - acetic acid absorbent)	Gas chromatography, ECD	5.2%	AIHA J. 44(3):151-5 (1983)	(49)
Trichloroethylene	Charcoal tube or Passive monitor	Gas chromatography, FID	8.2% (CT) 7.7% (PM)	NIOSH: S336 (Vol. 3, 2nd Ed.) or AIHA J. 42(10):752-6 (1981)	(68) (208)
Trichlorofluoromethane (Freon 11)	Charcoal tube	Gas chromatography, FID	7.2%	NIOSH: S102 (Vol. 2, 2nd Ed.)	(69)
Trichlorotrifluoroethane (Freon 113)	Charcoal tube	Gas chromatography, FID	7.0%	NIOSH: S129 (Vol. 2, 2nd Ed.)	(70)
Trinitrotoluene (TNT)	Tenax tube	Gas chromatography, ECD	5.3%	AIHA J. 42(8):586-9 (1981)	(65)
Welding fumes (total fumes)	Prewieghed PVC filter	Gravimetric, Anal. balance	MV	Inhouse procedure based on NIOSH: 0500 (3rd Ed.)	(31)
White phosphorus (yellow phosphorus)	Tenax tube	Gas chromatography, MPD	6.0%	NIOSH: 257 (Vol. 1, 2nd Ed.)	(71)
Xylenes	Charcoal tube	Gas chromatography, FID	6.0%	NIOSH: 1501 (3rd Ed.)	(11)
Zinc compounds	CE filter	Atomic absorption, flame	5.8%	NIOSH: 7030 (3rd Ed.)	(72)

Appendix B
IH Monitoring Supplies and Vendors
Section I. Tables

Table B-1
Containers

Sampler Type	Vendor	CAT No.
Glass container (25 mL), screw cap, Teflon disc	Pierce	13074 (Vials)
		12422 (Teflon Disc)
		13219 (Screw Cap)
	Alltech	9532 (Vials)
		95322 (Teflon Disc)
		95321 (Screw Cap)
	Supelco	2-3284 (15 mL)
		2-3285 (40 mL)
Plastic bottle 30 mL (1 oz)	Most scientific supply houses	Nalge 2002 or equal

Table B-2
Filters

Sampler Type	Size (mm)	Porosity (microns)	Suggested Vendor	CAT No.
Cellulose Ester (CE) (For asbestos)*	25	0.8	Gelman	64677
	25	0.8	Millipore	AAWP-025-0000
	25	0.8	Nuclepore	322575 (assembled)
Cellulose Ester (CE)	37	0.8	Gelman	64678 (GN-4)
	37	0.8	Millipore	AAWP-037-0000
	37	0.8	Nuclepore	321541 (2-piece, assembled)
Glass Fiber (For PCBs)	13	-	SKC	225-16
	37	-	Gelman	Type A/E
PTFE (Zefluor) (For PAH)	37	2	Gelman	P5PJ037
	37	2	Membrana	-
PVC	37	5	Gelman	66467
	37	5	Nuclepore	361850 Filter only 240810 Pad only
Swinnex Cassette (For PCBs)	13	-	Millipore	SX 00-013-0000

* Use 25 mm monitor with 50 mm conductive extension cowl.

Table B-3
Passive Monitors

Sampler Type	Suggested Vendor	CAT No.
Ethylene Oxide	3M	3551 (Monitor only)
Organic Vapor Monitor (For selected solvents)	3M 3M	3500 3520 (with backup section)
Pro-Tek Air Monitoring Badge (For selected solvents)	Dupont Dupont	Type GAA Type GBB (with backup section)

Table B-4
Tubes

Sampler Type	Size (mg)	Suggested Vendor	CAT No.
Alumina	1650/1650	SKC	ST 226-64
Ammonia	250/500	Supelco	ORBO 77
Charcoal (For solvents)	200/400	SKC	ST 226-09
	200/400	Supelco	2-0228
	50/100	SKC	ST 226-01
	50/100	Supelco	2-0267
	50/100	MDA	808101
Charcoal (For methyl bromide only)	200/400	SKC	ST 226-38-02
Chromosorb 102 (For pesticides)	50/100	SKC	ST 226-49-23-102
	50/100	Supelco	2-0264
	33/66	Supelco	2-0262
Chromosorb P for Acids (ORBO-70)	165/335	Supelco	ORBO-70
Ethylene Oxide	200/400	Supelco	ORBO-78
Florisil	50/100	SKC	ST 226-39
Formaldehyde	50/100	SKC	ST 226-45
Hydrazine	200/200	SKC	ST 226-42
Inorganic Acids (High Purity Silica Gel)	200/400	Supelco	ORBO-53
	200/400	SKC	ST 226-10-03
Nitrogen Dioxide (For KO ₂ , SO ₂)	400/600/400	Supelco	ORBO-76
ORBO-70	See Chromosorb P for Acids		
PAH (Polycyclic Aromatic Hydrocarbons)	50/100	Supelco	ORBO-43
Pesticide, OSHA	-	Supelco	Custom ORBO-80
Silica Gel	260/520	SKC	ST 226-15
Silica Gel, High Purity	See Inorganic Acids		
Silica Gel, H ₂ SO ₄ treated	100/200	SKC	ST 226-10-06
Tenax	50/100	SKC	ST 226-35-03
Tenax with built-in filter	50/100	Supelco	Custom ORBO-79
Thermosorb/N Air Sampler		Thermedics	6533
XAD-2	200/400	SKC	ST 226 30 06

Section II. Vendors

1. Alltech Associates, Inc.
Applied Science Labs
2051 Waukegan Road
Deerfield, IL 60015
(312) 948-8600
(800) 255-8324
2. E.I. Dupont de Nemours & Co., Inc.
Applied Technology Division
Wilmington, DE 19898
(215) 444-4035
(800) 344-4900
3. Gelman Sciences
600 South Wagner Road
Ann Arbor, MI 48106
(313) 665-0651
(800) 521-1520
4. Membrana Inc.
7070 Commerce Circle
Pleasanton, CA 94566-3294
(415) 846-8270
5. Millipore Corp.
Ashby Road
Bedford, MA 01730
(617) 275-9200
(800) 225-1380
6. Minnesota Mining & Mfg. Co.
Occupational Health & Safety
Products Division
3M Center, 220-7W-02
St. Paul, MN 55144
(612) 733-8465
(800) 328-1300
7. Nuclepore Corp.
7035 Commerce Circle
Pleasanton, CA 94566-3294
(415) 463-2530
(800) 882-7711
8. Pierce Chemical Company
PO Box 117
Rockford, IL 61105
(815) 968-0747
(800) 874-3723
9. SKC Inc.
RD 1, 395 Valley View Road
Eighty Four, PA 15330-9614
(412) 941-7701
(800) 752-8472
10. Supelco
Supelco Park
Bellefonte, PA 16823-0048
(800) 247-6628
(814) 359-3441
(814) 359-3446
11. Thermedics, Inc.
470 Wildwood St.
PO Box 2999
Woburn, MA 01888-1799
(617) 938-3786

Appendix C
Supporting Laboratories and Areas Served

Supporting laboratory

U.S. Army Environmental Hygiene
Agency
Field Support Activity
Fort McPherson, GA 30330-5000
AUTOVON 572-3234

U.S. Army Environmental Hygiene
Agency
Field Support Activity
Fitzsimons Army Medical Center
Aurora, CO 80045-5001
AUTOVON 943-8288

Commander
U.S. Army Pacific Environmental
Health Engineering Agency
Sagami
APO San Francisco 96343
Camp Zama 228-4111

Commander
10th Medical Laboratory
ATTN: AEMML-PM-LAB
APO New York 09180
Landstuhl Military (2223-)7272

Commander
U.S. Army Environmental Hygiene
Agency
ATTN: HSHB-ML-A
Bldg E2100
Aberdeen Proving Ground, MD
21010-5422
AUTOVON:
584-2619 (metals, quartz, asbestos)
584-2208 (solvents, organics, acid
mists, pesticides)

Areas served

Alabama, Arkansas, Florida, Georgia,
Western Kentucky, Louisiana,
Mississippi, Oklahoma, Panama,
Puerto Rico, South Carolina,
Tennessee, Central & Eastern Texas

Alaska, Arizona, California, Colorado,
Idaho, Illinois, Iowa, Kansas,
Michigan, Minnesota, Missouri,
Montana, Nebraska, Nevada, New Mexico,
North Dakota, Oregon, South Dakota,
West Texas, Utah, Washington, Wisconsin,
Wyoming

Hawaii, Japan, Korea, Okinawa,
Philippines, Thailand, and all other
Far East

Europe, Africa, Middle East, Western
Europe, Turkey, Africa, and Middle
East

- a. Worldwide support to laboratories
listed above
- b. Connecticut, Delaware, District of
Columbia, Eastern Kentucky, Indiana,
Maine, Maryland, Massachusetts, New
Hampshire, New Jersey, New York, North
Carolina, Ohio, Pennsylvania, Rhode
Island, Vermont, Virginia, West Virginia

Appendix D

Instructions for Completing AEHA Form 9-R, Industrial Hygiene Air Sample Data

1. Return address: Self explanatory.
2. Point of contact: Name and AUTOVON number of person in charge of sampling/project.
3. Samples collected by: Self explanatory.
4. Date collected: Self explanatory.
5. Date shipped: Date samples sent for analysis.
6. Associated bulk samples: Indicate whether bulk samples of materials used in the operation are being submitted along with corresponding air samples. If so, list the sample numbers which identify these bulks. Note: Bulk samples must be shipped separately from air samples.
7. Project number: For USAEHA and FSA use only.
8. Sampled installation: Self explanatory.
9. ARLOC: Army Location Code: reference - DA Pam 525-12 (CONUS) and 525-13 (Foreign).
10. Location (bldg/area): Self explanatory.
11. Description of operation: Briefly describe the industrial operation (e.g., degreasing metal parts, spray painting, vehicles, etc.)
12. Persons exposed/hrs per day: Self explanatory.
13. Method of collection: Air sampling medium used to collect samples (e.g., charcoal tube, 0.8 μ m CE filter, etc.).
14. Associated complaints: List worker complaints (e.g., dizziness, nausea, skin irritation, etc.) about exposure problems arising from operation.

15. Analysis desired: List specific parameters when they are known or suspected to be present; otherwise, indicate general type of analysis desired (e.g., unknown solvents, etc.).

16. Sampling data.

a. Sample number: Number assigned to the sample by field personnel.
Note: Use a consecutive numbering system so there is no duplication of numbers from batch to batch of samples. Number all samples including blanks.

b. Pump number: Identifying number for sampling pump (if used).

(1) Time on: Start time of pump (e.g., 1430).

(2) Time off: Stop time of pump (e.g., 1615).

(3) Total time: Sampling time in minutes (e.g., 105 min).

c. Flow rate: Sampling rate of pump in liters per minute. If the initial and final calibration flow rates are different, a volume calculated using the higher flow rate should be reported to the laboratory. If an overexposure can not be established using the higher flow rate, the industrial hygienist should recalculate the sample concentration using the lower flow rate. If the concentration using the lower flow rate exceeds the exposure limits, resampling should be considered.

d. Volume: Air volume sampled in liters.

e. GA/BZ: Enter GA if a general area sample or BZ if a breathing zone sample.

f. Employee name/ID: Self explanatory.

Note: Name and social security number is considered Privacy Act information and should be protected.

g. Laboratory number: Leave blank.

17. Results: Lab will provide results in the common conversion (such as ppm, mg/m³, f/cc, etc.).
18. Comments to lab: Insert any comments or information necessary on a particular sample.
19. Lab use only: Leave blank.
20. Calibration information: Self explanatory.
21. Operation: Self explanatory.
22. Personal protective equipment: Check box if equipment is worn. Specify type if applicable.
23. Field notes/additional comments: Self explanatory.

Appendix E
Instructions for Completing AEHA Form 8-R, Bulk Sample Data

1. Return address: Self explanatory.
2. Point of contact: Name and AUTOVON number of person in charge of sampling/project.
3. Sampled installation: Self explanatory.
4. Project number: For USAEHA and FSA use only.
5. ARLOC: Army location code - reference DA PAM 525-12 (CONUS) and 525-13 (Foreign).
6. Samples collected by: Self explanatory.
7. Date collected: Self explanatory.
8. Date shipped: Date samples sent for analysis.
9. Description of operation: Brief description of the industrial operation (e.g., degreasing metal parts, spray painting vehicles, etc.).
10. Location (bldg/area): Self explanatory.
11. Associated complaints: Worker complaints about exposure problems arising from operation (e.g., dizziness, nausea, skin irritation, etc.).
12. Associated air samples: If air samples corresponding to these bulks are submitted for analysis, please so indicate and list the sample numbers which identify these air samples. Air samples must be shipped separately from bulk samples.
13. Label information:
 - a. Trade name: Self explanatory; if unknown, so indicate.

- b. NSN: If available, so indicate.
 - c. Manufacturer: Self explanatory; if unknown, so indicate.
 - d. Address: Self explanatory; if unknown, so indicate.
 - e. MSDS: Attach the MSDS whenever possible and so indicate.
14. Analysis desired: List specific parameters when they are known or suspected to be present otherwise, indicate general type of analysis desired (e.g., unknown solvents, etc.).
15. Lab use only: Leave blank.
16. Sample number: Number that field personnel assigns is the sample number. Use a consecutive numbering system so there is no duplication of numbers from batch to batch of samples.
17. Constituents: Leave blank.
18. Results: Leave blank.
19. Remarks: Leave blank.
20. Comments to lab: Use for any general information or remarks you wish to include.
21. Lab use only: Leave blank.

Appendix F
References

Section I.
Required Publications

DOD 6050.5-L

(DOD Hazardous Materials Information System Hazardous Item Listing). Cited in paragraph 7c. (This listing is available from the U.S. Army AG Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DOD 6050.5-LR

(DOD Hazardous Materials Information System Hazardous Item Listing). Cited in paragraph 7c. (This listing is for U.S. Government use only limited because it contains proprietary (limited rights) data. Copies are available from the U.S. Army AG Publication Center, 2800 Eastern Blvd., Baltimore, MD 21220-2896.)

DA Pamphlet 525-12

(Army Location Codes - CONUS). Cited in appendixes D and E.

DA Pamphlet 525-13

(Army Location Codes - CONUS). Cited in appendixes D and E.

Section II.
Related Publications*

Title 49 CFR Chapter 1,
Subchapter C

(Hazardous Materials Regulations)

* A related publication is merely a source of additional information. The user does not have to read it to understand this document.

DHEW (NIOSH) Publication
No. 75-120

(Criteria for a Recommended Standard:
Occupational Exposure for Crystalline
Silica) (This publication is
available from Publications
Dissemination, DTS, NIOSH, 4676
Columbia Parkway, Cincinnati, OH
45226.)

DHEW (NIOSH) Publication
No. 76-105

(Criteria for a Recommended Standard:
Occupational Exposure to Sodium
Hydroxide) (This publication is
available from Publications
Dissemination, DTS, NIOSH, 4676
Columbia Parkway, Cincinnati, OH
45226.)

DHEW (NIOSH) Publication
No. 77-140

(Criteria for a Recommended Standard:
Occupational Exposure to Waste
Anesthetic Gases and Vapors) (This
publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 77-147A

(Manual of Analytical Methods, Vol 1)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 77-157B

(Manual of Analytical Methods, Vol 2)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 77-157C

(Manual of Analytical Methods, Vol 3)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 78-175

(Manual of Analytical Methods, Vol 4)
(This publication is available from
Publications Dissemination, DTS,
NIOSH) 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 79-141

(Manual of Analytical Methods, Vol 5)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 80-125

(Manual of Analytical Methods, Vol 6)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHEW (NIOSH) Publication
No. 82-100

(Manual of Analytical Methods, Vol 7)
(This publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

DHHS (NIOSH) Publication
No. 84-100

(NIOSH Manual of Analytical Methods.
3rd Ed., Peter M. Eller, Editor) (This
publication is available from
Publications Dissemination, DTS,
NIOSH, 4676 Columbia Parkway,
Cincinnati, OH 45226.)

TLVs® Booklet

(TLVs® - Threshold Limit Values and
Biological Exposure Indices for the
current year.) (This publication
is available from ACGIH, 6500 Glenway
Ave., Bldg D-5, Cincinnati, OH 45211.)

APPENDIX G
Selected Bibliography

Belkin, F. and R. W. Bishop. The New U.S. Army's Industrial Hygiene Sampling Guide. American Society for Testing Materials Special Technical Publication 957. To be published (1987).

Bishop, R. W., T. A. Ayers, and D. S. Rinehart. The Use of a Solid Sorbent as a Collection Medium for TNT and TDX Vapors. Am. Ind. Hyg. Assoc. J. 42:586-589 (1981).

Bishop, R. W., et al. A Gas Chromatography Procedure for the Determination of Airborne MDI and TDI. Am. Ind. Assoc. J. 44(3):151-155 (1983).

Bishop, R. W., F. Belkin, and R. J. Gaffney. Evaluation of a New Ammonia Sampling and Analytical Procedure. Am. Ind. Hyg. Assoc. J. 47:135-137 (1986).

Charell, P. R. and R. E. Hawley. Characteristics of Water Absorption on Air Sampling Filters. Am. Ind. Hyg. Assoc. J. 42:353-60 (1980).

Documentation of TLVs and BEIs. American Conference of Governmental Industrial Hygienists, fifth edition (1986).

Dolzine, T. W., G. G. Esposito, and R. J. Gaffney. Determination of Hydrogen Cyanide in Air by Ion Chromatography. American Society for Testing Materials Special Publication 786 (1982).

Eiskamp, C. J. and G. R. Schultz. An Alternate Sampling and Analytical Method for 2-Butanone. Am. Ind. Hyg. Assoc. J. 44:201-204 (1983).

Esposito, G. G. and T. W. Dolzine. Determination of Airborne 1,6-Hexamethylene Diisocyanate by Gas Chromatography. Anal. Chem. 54:1572-1575 (1982).

Esposito, G. G., et al. Determination of Ethylene Oxide in Air by Gas Chromatography. Anal. Chem. 56(11):1950-1953 (1984).

Feigley, C. E. and J. B. Chastain. An Experimental Comparison of Three Diffusion Samplers Exposed to Concentration Profiles of Organic Vapors. Am. Ind. Hyg. Assoc. J. 43:227-234 (1982).

- Mazur, J. F., et al. Evaluation of a Passive Dosimeter for Collection of 2-bromo-2-chloro-1,1,1-trifluoroethane and 2-chloro-1,1,2-trifluoroethyl difluoromethyl ether in Hospital Operating Rooms. Am. Ind. Hyg. Assoc. J. 41:317-321 (1980).
- Mazur, J. F., et al. Evaluation of Passive Dosimeters for Monitoring Vapor Degreaser Emissions. Am. Ind. Hyg. Assoc. J. 42:752-756 (1981).
- Mullins, H. E. Sub-part-per-million Diffusional Sampling for Ethylene Oxide with the 3M #3550 Ethylene Oxide Monitor. Am. Ind. Hyg. Assoc. J. 46:625-631 (1985).
- Organic Methods Evaluation Branch, OSHA Analytical Laboratory, Method No. 27: Volatile Nitrosamine Mixture I. Salt Lake City, Utah, Feb 1981.
- Roper, E. M. and C. G. Wright. Sampling Efficiency of Five Solid Sorbents for Trapping Airborne Pesticides. Bulletin of Environmental Contamination and Toxicology. 33:476-483 (1984).
- Rose, V. E. and Perkins, J. L. Passive Dosimetry - State of the Art Review. Am. Ind. Hyg. Assoc. J. 43:605-621 (1982).
- Sax, N. I. Dangerous Properties of Industrial Materials. Van Nostrand Reinhold Company. 6th edition (1984).
- Vinjamoori, D. V. and Chaur-Sun-Ling. Personal Monitoring Method for Nitrogen Dioxide and Sulfur Dioxide with Solid Sorbent Sampling and Ion Chromatographic Determination. Anal. Chem. 53:1689-1691 (1981).
- Williams, K. E., G. G. Esposito, and D. S. Rinehart. Sampling Tubes for the Collection of Selected Acid Vapors in Air. Am. Ind. Hyg. Assoc. J. 42:476-478 (1981).

GLOSSARY

APG.....Aberdeen Proving Ground
 CE.....cellulose ester
 CONUS.....continental United States
 Cr.....chromium
 CT.....charcoal tube
 CV.....coefficient of variation
 DOD.....Department of Defense
 ECD.....electron capture detector
 ETO.....ethylene oxide
 FAMC.....Fitzsimons Army Medical Center
 FID.....flame ionization detector
 FPD.....flame photometric detector
 FSA.....field support activity
 GF.....glass fiber
 HMIS.....hazardous materials information system
 ICP.....inductively coupled plasma
 ID.....inside diameter
 IH.....industrial hygiene
 LR.....letter requirement
 MSDS.....material safety data sheets
 NIOSH.....National Institute for Occupational Safety and Health
 NPD.....nitrogen phosphorus detector
 NV.....not validated
 OCONUS.....outside continental United States
 PCB.....polychlorinated biphenyls
 PM.....passive monitor
 PTFE.....polymer of tetrafluoroethylene
 PVC.....polyvinyl chloride
 TDI.....toluene diisocyanate
 TLV.....threshold limit value
 TNT.....trinitrotoluene
 TWA.....time weighted average
 USAEHA.....US Army Environmental Hygiene Agency
 UV.....ultraviolet

INDUSTRIAL HYGIENE AIR SAMPLE DATA

For use of this form see USAEHA TG 141; the proponent is HSHB-LO.

Return Address (complete address including Zip Code)				Point of Contact (name/AUTOVON)			
Samples Collected By		Date Collected		Date Shipped		Associated Bulk Samples <input type="checkbox"/> Yes <input type="checkbox"/> No Bulk Sample No(s):	
Project Number		Sampled Installation				ARLOC <div style="border: 1px solid black; width: 100px; height: 20px; display: flex; justify-content: space-around;"> </div>	
Location (BLDG/AREA)		Description of Operation (details on reverse)					
<input type="checkbox"/> Persons Exposed <input type="checkbox"/> Hrs/Day		Method of Collection					
Associated Complaints (be specific) (state NONE if applicable)							
Analysis Desired							
Sampling Data							
Sample No.							B L A N K
Pump No.							
Time On							
Time Off							
Total Time (min)							
Flow Rate (LPM)							
Volume (Liters)							
GA/BZ							
Employee Name/ID							
Laboratory No.							
Results							
Comments to Lab:							
Lab Use Only							
Analyst (initials)		Reviewed By (initials)		Date Received		Date Dispatched	

AEHA Form 9-R, 1 Oct 84

Replaces AEHA Form 9, 1 Oct 80 which is obsolete.

Calibration Information				
Pump No.	Calibration (L/min)		Rotometer Setting	Date
	Pre-Use	Post-Use		
			Name of Calibrator	
Operation				
Source of Contaminant:				
Operation Employee(s) Perform:				
Ventilation: <input type="checkbox"/> Local Exhaust <input type="checkbox"/> General Area <input type="checkbox"/> None				
Personal Protective Equipment (check if worn)				
<input type="checkbox"/> Respiratory Protective Equipment Type: _____				
<input type="checkbox"/> Protective Clothing Type: _____				
<input type="checkbox"/> Gloves Type: _____				
<input type="checkbox"/> Goggles/Face Shield				
<input type="checkbox"/> Ear Protection				
<input type="checkbox"/> Other: _____				
Field Notes/Additional Comments				

BULK SAMPLE DATA

For use of this form see USAEHA TG 141; the proponent is HSHB-LO.

Return Address (complete address including Zip Code)		Point of Contact (name/AUTOVON)		
Sampled Installation	Project Number	ARLOC [][][][][]		
Samples Collected By	Date Collected	Date Shipped		
Description of Operation		Location (BLDG/AREA)		
Associated Complaints (be specific)				
Associated Air Samples If yes, list sample numbers <input type="checkbox"/> Yes <input type="checkbox"/> No				
Label Information				
Trade Name		NSN	Manufacturer	
Address		MSDS Attached <input type="checkbox"/> Yes <input type="checkbox"/> No		
Analysis Desired				
Lab Use Only	Sample No.	Constituents	Results	Remarks
Comments to Lab:				
Lab Use Only				
Analyst (initials)	Reviewed By (initials)		Date Received	Date Reported
Procedures Performed		Comments:		